

APPENDIX G
SAGEBRUSH AND PINYON-JUNIPER ECOLOGY AND RESTORATION WORKSHOP

**Grand Staircase-Escalante
National Monument**

Bureau of Land Management
190 E. Center Street
Kanab, UT 84741

Phone 435-644-4300
Fax 435-644-4350

Sagebrush and Pinyon-Juniper Ecology and Restoration

A Workshop Lead by Dr. Steve Monsen

Sponsored by the Grand Staircase-Escalante National Monument

Introduction

As an offshoot of the Buckskin Mountain Landscape Assessment for Wildlife Habitat Improvement on the Grand Staircase Escalante National Monument, a three-day workshop was organized to discuss and explore sagebrush and pinyon-juniper woodland ecology and restoration. Dr. Steve Monsen was invited to conduct the workshop, which took place May 11-13, 2004. See Appendix A for a Biography on Dr. Monsen. Specialists from various disciplines from neighboring agencies were invited to participate as well as cattle permittees (Appendix B). A detailed agenda for the workshop can be found in Appendix C, and additional requested agenda items can be found in Appendix D.

Special thanks goes to the following individuals who took and shared their copious notes: Laura Fertig, Holly Beck, and Mikele Painter.

Workshop Participants

<i>Name</i>	<i>Title</i>	<i>Organization</i>
Barber, Harry	Assistant Monument Manager for Biological Science	GSENM
Beck, Holly	Botanist	GSENM
Bowns, Jim	Professor	Univ. of Southern Utah, Southern Utah Univ.
Bronson, Adam	Wildlife Biologist	Utah Division of Wildlife Resources
Chapman, Paul	Resource Advisor	GSENM
Chaudhary, Bala	Graduate Student	Northern Arizona University
Church, Lisa	Wildlife Biologist	Kanab Field Office
Decker, Cheryl	Horticulturist	Zion National Park
Despain, Del		Univ. of Arizona
Eaton, Marietta	Assistant Monument Manager for Cultural and Earth Sciences	GSENM
Fertig, Laura	Botanist	GSENM
Franklin, Scot	Wildlife Biologist	Arizona Strip BLM
Gisler, Jan		Friends of the Monument
Goheen, Andrew	Fuels Specialist	Arizona Strip BLM
Goheen, Sue	Soils Scientist	GSENM
Habbeshaw, Mark	Kane County Commissioner	Kane County
Hatch, Julian		Greater Boulder Group
Hughes, Amber	Biologist	GSENM
Hughes, Lee	Ecologist	Arizona Strip BLM
Hunsaker, Dave	Monument Manager	GSENM
Kolle, Liz		
Louie, Denise	Vegetation Manager	Zion National Park
Malm, Margaret		Zion National Park
Marlin, Yvonne	Restoration Biologist	Zion National Park
McKee, Norman	Biologist	Utah Division of Wildlife

Monsen, Steve	Botanist/Ecologist	Resources, Retired USDA Forest Service, Rocky Mountain Research Station, Shrub Sciences Project, Retired
Oyler, Rick	Rangeland Specialist	GSENM
Painter, Mikele	Wildlife Biologist	North Kaibab Ranger District
Palmer, Brett	Range Technician	GSENM
Pierson, Brett	Range Technician	GSENM
Pope, Dennis	Biological Lead	GSENM
Redman, Andrea	Graduate Student	Northern Arizona University
Reid, Chad	Extension Agent	University of Southern Utah
Siders, Missy	Wildlife Biologist	GSENM
Smith, Don	Range Conservationist	North Kaibab Ranger District
Stewart, Sean	Rangeland Specialist	GSENM
Stonex, Scott	Fuels Assistant	North Kaibab Ranger District
Thomas, Kyra	Wildlife Biologist	North Kaibab Ranger District
Thompson, Tyler		Utah Division of Wildlife Resources
Torgerson, Ron	Range Conservationist	SITLA
Warner, Barb	Director	Kanab Institute for Field Studies
Zimmerman, Mary Lou	Ecologist	GSENM

Organizers and Preppers of the Notes

Missy Siders
Wildlife Biologist

Mary Lou Zimmerman¹
Ecologist
Grand Staircase-Escalante National Monument
190 E. Center Street
Kanab, UT 84741

¹ Current: Supervisory Natural Resource Specialist—Operations, Three Forks Zone (Hungry Horse, Glacier View, Spotted Bear), Flathead National Forest, P.O. Box 190340, Hungry Horse MT 59919

Day

1

Sagebrush Die-off and Failed Seedlings

Sagebrush and Pinyon-Juniper Ecology and Restoration

A WORKSHOP LEAD BY DR. STEVE MONSEN

Stop 1: Five-mile Mountain seeding and sagebrush die-off

Concerns: Lack of understory, cheat grass (BRTE) invasion, several fires have occurred in the area

This area was prioritized for restoration due to extensive sagebrush die-off. Questions about the cause of die-off. There was a warm-up in Jan/Feb this past year. Could have been that the sagebrush came out of dormancy too early, used up moisture in the leaves, then foliage died back. However, the vigor looks good in these plants. Appears to be many seedlings. Sagebrush will probably survive without management intervention.

There appears to be a universal die-off of sagebrush in the West currently. Big concern and push for something to be done.

Expansive die-off was seen in the past. 1983-85 was unusually wet years, which resulted in another large sagebrush die-off. There was a lot of concern at the time. Dave Nelson did survey and mapped sagebrush die-off. Within two years the sagebrush was back to original distribution and density.

The key issue at this spot is re-establishment of sagebrush. Re-establishment is better with sagebrush overstory. Burning hurts sagebrush regeneration. Need to keep some kind of cover and/or litter for seedling establishment. Cheatgrass probably will not invade this site because sagebrush cover is high enough to exclude it. As long as the sagebrush stays alive we probably won't have a problem with cheatgrass invasion.

Make sure to use plant species that were here. Native plants and local seed sources are better adapted to the sites and will result in better establishment. Don't use the Indian ricegrass seed from Boise, Idaho. Wouldn't work here. Need to really think about what your seed source is, especially for large treatment areas. Natives can be hard and/or expensive to obtain.

Seeding: Steve Monsen recommends using site-specific native grass and forb seed; also want to REALLY diversify species mix (globe mallow, stipa, galleta, ricegrass, grama, etc.). Can also use range site descriptions or nearby rights-of-way to try and approximate what species to use. Just remember that roadside rights-of-way may have different management (spraying, mowing, etc), and is not a "pre-settlement" approximation.

Seeding method matters: drill-holes are much more persistent, broadcast seeding is not as persistent

Site is in need of an improved understory community of plants and improved grazing regime – this site has been overgrazed.

Crested wheat grass has three commercial types: Fairway (*Agropyron cristatum*), Standard (*A. desertorum*), and Siberian (*A. fragile*) [Note: different sources list various combinations of these common and Latin names. The combinations listed above come from an article in Crop Science, since it most closely approximated what I thought Steve said. FYI, Welsh says that *A. cristatum* and *A. fragile* are the same thing.²]. There are different cultivars within these types that were developed for use in different management situations. Then there is Pubescent wheatgrass (*A. trichophorum*), which is not a type of crested wheatgrass at all, and Desert wheat grass (Nordan).

Fairway crested wheatgrass will disappear in approx. 20 – 30 years in this area but needs more rain than we have here. Fairway variety looks like a golf course when clipped. Pubescent wheat grass and standard wheatgrass are aggressive and will not disappear. Some plants live for 60 years. Standard wheat grass can reproduce. Does not succumb to competition. Does not move off site. Clumpy character. Siberian wheatgrass is not aggressive but won't disappear either. Unless you specify what crested wheat grass you want, you will get a mix of the cheaper varieties, which may not be what you want. Also, the different varieties respond differently on-site, which is one reason why seeding success varies. All of these species out-compete natives.

Drilling seed will create more difficult environment for other invaders. Drill rows should be spaced 18" apart. Plants will stay in these rows, won't spread out of them. Broadcast seeding is more likely to have exotic species invasion.

What was the native understory at Five Mile site? May have been stipa, squirrel tail, galletta, and Indian rice grass. Knocked out by livestock grazing. Generally grasslands are on sandy soils. Galletta can be on more clay rich soils.

It will be challenging to reseed Five Mile. Don't burn it. It usually takes grasses 7-20 days for seed to imbibe water and germinate, so the soil has to be moist for that long. How often do you have those kinds of conditions? Not very often, and that makes seeding more difficult because the soil is too dry. It's critical to seed in the fall, and to have enough overstory and litter to keep the soil moist.

The success of a seeding depends on the techniques you're using. During seeding, you need to maintain some kind of surface protection, reduce competition, but maintain cover for moisture. The "Old" method that worked well in sagebrush was to drag a 1" cable between two cats to remove approx 60% of sagebrush cover. Can adjust cable use to get various removal results.

Mechanics of chaining was a good tool. Much better than disking, leveling soil, drill seeding, etc., with less soil disturbance. You can adjust amount of cover removal to as little as 20% depending on how used, type of chain, number of swivels, etc. Does not influence understory. A drill

² L. Fertig. Pers. Comm. Grand Staircase Escalante National Monument, Botanist.

disturbs 80% of the soil surface. They cut into the soil surface 2-3", with side casts of 4" of soil. Disturbs more of the soil surface than chaining. The Lawson aerator is another tool to break up sagebrush.

Indian ricegrass requires seeding to a 3" depth, has to be drill seeded. Squirrel tail doesn't need to be buried. At Five Mile, we may need to decrease sagebrush to re-seed the understory.

Sagebrush only needs a few plants to have recruitment. Presettlement may have had fire or die-off episodes to break up the canopy cover, resulting in different age groups, and a mosaic. Constant but slow recruitment of plants.

Need to get the understory back to restore the natural fire regime, then the system will restore itself. But will be hard to do that. Large expanses needed to prevent wildlife and livestock from concentrating use.

In this area, average annual precipitation is 10-12". Fall treatment should be successful.

NRCS is developing ecological site descriptions based on soil, precipitation, percent composition, etc.

10-20% canopy cover of sage is the general rule (lose 10% understory with 1% increase in canopy cover, according to Jim Bowns, but Monson doesn't agree with this rule of thumb.)

To maintain favorable soil moisture for successful seed germination you need to protect the soil and reduce competition from overstory.

Sagebrush probably grew (presettlement) in a mosaic of different age classes; maintained by fire, natural plant life-span, and regular but infrequent die-offs

Stop 2: "Failed" seedings in the Telegraph Flat Pasture

This is a grazed allotment with major exotic forb problem (Russian thistle, sunflowers, etc.). This area was plowed and seeded in the 1960s. Trend was read in 1997 and had good crested wheat stand (monoculture). Now gone. Was good and intact until drought, although soil condition is unknown. Area where we were standing is a flood plain area with deep loam to clay loam soil. Floods occasionally. Weedy site now has many annual sunflowers, Russian thistle, etc.

Cheat grass is very opportunistic. General thought was that cheat grass was evolving to fit new niches. But further study shows that there have been additional invasions of other varieties of cheat grass. Shrub lab research is looking at different strains of cheat grass and associated strains of smut that infect it. There are some 20 different lines of cheat grass, each with different characteristics. An area can have several strains that grow together, but do not cross. One strain may dominate for a while until a smut takes infects it to a level that that strain dies out. There are genetic differences between the different cheat grass strains. Shrub lab is looking at ecotypes and mapping them.

The cheatgrass here does not have a dormant period.

Cheat grass requires some degree of surface disturbance to become established. Normally will not invade intact sagebrush grasslands.

Goal for this area is to control the exotic component, and to encourage the development of the native understory, especially the native grass component. Secondary goal is to control erosion and stabilize soils.

Russian thistle isn't that competitive. It does not displace other plants. You can generally seed into a Russian thistle site with some success. Russian thistle germinates in the spring but most of the growth is in the summer. It is almost impossible to remove the seed source. Russian thistle is a very prolific seed producer. You can spray with an herbicide, but it may take multiple years of treatment to out live the seed source. If you don't come back in the next year, just a few individuals and produce enough seed to take you back to where you started.

Flood plain area may have been a four-wing saltbush site instead of sagebrush. Four-wing does better in occasionally wet sites. Need to be able to distinguish areas that should be four-wing from areas that should be sagebrush. Map soil types in area to be restored to figure out what should be here.

You don't have to worry about losing sagebrush at this site. There are plenty of healthy plants to provide a seed source. What is needed is to get the right understory of native plants. Need site adapted seed source for best success.

If needed, you could use crested wheat for seeding in the mean time. Native seed sources are limited and expensive. Reality may deem that exotics are needed to stabilize soil on sites and control weeds. However, you should work on moving toward native. Western wheatgrass may be a better option for the lower/wetter sites. Could be mixed with crested wheatgrass. Western wheatgrass germinates in the spring, but also greens up in the fall, so is a good forage plant.

Using a mix of crested wheat and native grasses, forbs and shrubs does not work well. Crested wheat out competes and displaces native plants. Scott Walker study saw that in average precipitation years crested wheat flourished. In drought years, natives did better. Overall, natives are inhibited by crested wheat plants. Crested wheatgrass solves immediate problems such as weed and erosion control, providing forage, but won't work in the long term if you want to restore native communities.

Part of the problem with restoration of native plant species is that under natural conditions usually only 2% of the native seed actually germinate and survive. The natural system is slow regeneration over time. With restoration treatments we want a large area to have very good germination and survival in a relatively short time period. The reason crested wheat grass has been used in the past is that it has good and consistent germination, inexpensive, and it stays green as long as there is soil moisture, regardless of temperature. Most native grasses grow in spring and quit when it gets warm. Native communities are diverse because moisture patterns vary, which favors different species at different times. Crested wheat uses all the moisture all the time, so it is favored over natives.

For better success with native seed, plant seed in mid-Fall or winter after snow; reduce sagebrush cover; complete seedings over a 5-year time period, get rid of weeds first with a pre-emergent chemical. Treat in spring, then in summer, then seed in fall. Don't plow. Add four-wing salt bush seed in lower areas; shadscale along the foothills and maybe *Ephedra nevadensis*. Mycorrhizae are needed for success of some plants. If natives are available, plant 2-3 lbs/acre. Don't plant standard crested wheat, plant Fairway, which will die off in 20 years. Drill seed western wheatgrass, which will eventually dominate.

Need to look at restoration a landscape level, not small areas, otherwise we concentrate animals on treated areas. Need to be able to spread use out. Success of restoration is dependent on the health of the surrounding area as well as what is done at the site. Once you treat an area, you are not done. It may take some time and multiple treatments to get the system back to some form of "normality."

At this time, may need to mow this site to reduce sagebrush cover. The young sagebrush is too small and flexible for other treatments. Or chain in winter, when plants are more brittle and easier to kill.

Lunch stop talk with Laura: Crested wheatgrass forms monocultures, which leads to problems with disease and infestation by exotic species. Doesn't provide a lot of vegetative structure for wildlife, such as sage grouse, and out competes the forbs that they need. Predicts that perennial weeds are going to become the problem of the future, making these annual weeds look like a walk in the park. Crested wheatgrass monocultures can be taken over by these weeds.

Most important management need for the Monument's restoration program is to create a prioritization scheme for all the areas you want to restore. Choose areas that still have a good understory that can be improved easily and relatively inexpensively, with a greater chance of success.

Stop 3: "Failed seedings and old burn in Seaman Wash

Seaman wash area was a prescribed burn in the mid-1990s. Area was seeded with a mix of crested wheat, Russian wild rye, four-wing, and other native grasses, forbs and shrubs. Included forage kochia. Wildfire burned over part of the area afterward and again seeded. Parts of the area have good crested wheat cover, but much of the area is cheat grass or Russian thistle.

Looking at the Russian thistle wash site. Russian thistle is a dominant component in the low flats and washes. Area was treated by fire crews at some point. Does flood on occasion (pooling near road).

Basin wild rye works well with some flooding. Western wheat grass would compete well with Russian thistle. Options for treatment at this site are to either spray for a couple years then seed, or just seed heavily so that the seeded component out competes the Russian thistle. Russian thistle seed bank is a great concern here.

Upcoming threats to the West are perennial weeds. Currently most of our weed problems are annuals. Annual weeds are being replaced with perennials in other regions of the West. Upcoming threats are star thistle, squarrose knapweed, and skeleton weed. Pinyon-juniper woodland, with its moist, open understory, is a prime area for these invasions.

Medusa head rye is a new nasty weed that is also an up and coming threat. Animals won't eat it; doesn't decompose; and thus takes over. Medusa head rye is already in southern Idaho and northern Utah.

There is a small amount of Scotch thistle in the wash. This is a much worse threat than the Russian thistle. Scotch thistle needs to be dealt with soon or it will spread rapidly.

To treat Russian knapweed, spray when it's dormant with Curtail (2,4-D plus chlorthaloprophos). You can use less chemical with winter treatments.

We must be vigilant, diligent, and creative if we are to protect and rehabilitate areas with exotic weed problems. We need intact communities with a full compliment of species. Monocultures aren't as effective at controlling weeds.

Looking at the grass hilltop areas of Seaman Wash. If you want to get sagebrush back into this system, you cannot seed sagebrush seed directly into the grass cover. You will have a very low success rate due to competition. The results will be similar with other shrub species (four-wing salt bush, cliffrose, etc) in this area. Also, sagebrush seedlings are very susceptible to frost. Most seedlings are killed by frost.

Why worry about seeding sagebrush into the Seaman wash area? There is plenty of sagebrush in the surrounding area, and it will eventually move in. Would be better to focus more on native grasses and forbs for the area.

Lee Hughes: "Grazing is obviously a problem here."

Stop 4: Kanab Field Office site near Mt. Carmel Junction

Treatment site on Kanab Field Office. This is a higher elevation site (approx. 7000 ft?), and has higher annual precipitation than sites we have been looking at. Area receives approx. 13-14" average precipitation per year. Chaining treatment was finished in 1984. Seed was aerially seeded and back-chained. In 1995, area was re-treated for maintenance by hand crews to remove small junipers. Last year (2003), area was again treated for maintenance using the Bullhog to remove small trees.

Paul Chapman explained that the seeding did not work well at first. The seed lay dormant for about two years after seeding. The permittee was allowed back on to the area to try "Hoof Action" to get the seed to germinate. The area did then germinate, but it could have been due to a good precipitation year, or hoof action, or both. Would have been nice to have a controlled study to determine the actual effects.

Pre-treatment species included oak, mormon-tea, snakeweed, snowberry, and ponderosa pine. Area has a lot of non-native grass in the area. Would be interesting to monitor over time.

**Day
2**

Buckskin Mountain: Pinyon-Juniper Encroachment, Mountain shrub enhancement, Sagebrush Die-off

Stop 5: Old Pushes (PJ treatments in sagebrush) on Buckskin

There are two cattle allotments in this area: Mollie's Nipple and Vermilion. Mollie's Nipple allotment has poor cow rotation because there are too few waters to disperse use across this large single pasture.

Just enough cheat grass that it could become a problem if sagebrush and cover and competition is reduced. If this area is managed through passive methods instead of active methods, it might come back. Grazing is preventing it from recovering by itself.

In arid sagebrush environments, passive methods won't work. Even with rest-rotation grazing system you won't rest or create enough seed source to get restoration of understory. You will need to be aggressive to get grass back into this location. Need to reduce overstory competition by 50% to get grass component here. Sagebrush at this site is using all the available moisture, so we have to reduce it so moisture is available for seeds.

This area appears to be heavily browsed. Watch how much you treat of the sagebrush so that you don't impact the deer herd and concentrate animals on treatment sites. Rehabilitate the area in stages, rather than all at once. You could aerate or chop sagebrush and re-seed at the same time.

Livestock use appears excessive here. Need to get a handle on livestock use, or restoration efforts will not be successful.

This site should have good response to restoration treatment. Better than site No. 1.

Once grass seedlings get established, then they can compete with sagebrush.

Sage grouse publication (Al Sands) stated that 20-25% (Wyoming) sagebrush cover has good understory. Above that grasses are reduced. One theory is that sagebrush sites will ultimately move to sagebrush dominated site with no understory. Only way to maintain is to burn.

Steve does not agree with this part. He thinks that the sagebrush increase was due to grazing pressures. Drought, insects and die-off effects sagebrush density dramatically. Natural disturbance should be adequate enough to create open areas in sagebrush and maintenance of understory.

Grasses and forbs are more limited in this more arid environment and more susceptible to grazing. Need to make major changes in management to make improvement.

Can look at age class of juniper stands to determine encroachment. Area south of site has predominantly younger juniper trees. PJ encroachment occurred in the last half-decade or so. This area was probably more of a savannah before encroachment. Encroachment was probably due to grazing and fire changes. Need to put fire back into system, or mechanical treatment if fire is not realistic; and work on understory recovery. Once treated, there will continue to be effects from old system. Seed bank from previous vegetation cover (pinyon-juniper, weeds etc.) will continue to come in.

Manage systems as they naturally occur. May need to get fire in the system. Watch grazing so that grass is reduced and can't compete with trees.

Pinyon-juniper communities have been highly altered from pre-European settlement. They are now more dense and have a reduction if not loss of the understory component.

Put more management emphasis on treating pinyon-juniper woodland than sagebrush community. Steve thinks that in the pinyon-juniper system we will get "more bang for the buck" in terms of restoration.

Robin Tausch (Rocky Mountain Research Station, Nevada) has done a lot of work in pinyon-juniper ecology and has some interesting papers that are applicable to what we are trying to do. Steve can send copies. Pinyon-juniper cover typing and mapping of the pinyon-juniper communities and associations. Steve thinks the information would be very helpful for our area.

Focus on pinyon-juniper areas where there are still shrubs and a native seed source. Pinyon-juniper sites usually have more precipitation than sagebrush. This leads to greater probability for successful restoration. Once tree cover is removed, the mechanical treatment creates a good seedbed, and existing or supplemental seed will have good chance.

Bullhog vs. Chaining

Bullhog may not create a good seedbed. There was a question as to whether the mulch created by the bullhog would create a seedbed for cheat grass and add to its ability to out compete native seed. Steve felt that the mulch probably does not create a better seedbed for cheat grass. Cheat grass is a surface germinator, i.e. it does not need to get underground. So mulch would not aid in its germination.

Roller-chopper or chaining is much more cost effective than Bullhog treatment. Chaining runs about \$30/acre, and with seeding runs about \$80/acre. Bullhog treatment runs about \$200-300/acre. Chaining will create a seedbed.

On concern with Bullhog treatment is that it may not create much of a seedbed. Steve emphasized that you must create a seedbed for successful germination for restoration purposes. Without the seedbed, germination will be reduced.

Other Options

General feeling is that Spike works to reduce overstory competition (i.e. kills trees & shrubs), but is moisture dependent. Spike can be used to conduct very targeted treatments, if you only want to remove certain components. However, it also does not create the needed seedbed for good germination.

Patch or strip treatment options? Need to look at treatment types economically and ecologically. You don't want to open too large an area. Leave as much litter as you can given other restraints (fuel loads, etc.). You do need to make the treatment area large enough to deal with deer herd use. If too little area is treated, deer browsing will impact it.

Roller chopper – litter stays right where it was.

Dixie harrow – picks up debris and carries it around.

Stop 6: Sagebrush die-off

Sage grouse discussion

This area is part of the historic range of the sage grouse. Not likely to currently have sage grouse on the Monument. Adjacent area to the Monument has a very small population. Estimations are that 7-9 cocks strut there in the spring (strutting grounds). Despite efforts, little is known about where they go outside of the strutting season, or what neighboring habitats they may be using. There were historic breeding and strutting grounds within the Monument boundaries. These areas have been converted to farming and no longer support sage grouse.

Current concerns are to restore the sagebrush communities to a state that would be more suitable for sage grouse, even though we may never have any. Current state of the sagebrush communities is too dense and does not have the grass and forb component needed for nesting and poult rearing. Grasses and forbs are critical for poults. Rely on forbs and insects during part of the year.

Gullies

There are gullies and erosion problems within the dense sagebrush areas. Before you can deal with the gullies directly, you need to fix the vegetation (ground) cover problems, and decrease overland flows. Then you can deal with the gullies.

Chaining

If you treat this area with chaining in late summer or fall, the chain will work differently than in winter. During the late summer or fall, plants are more flexible, and less likely to break. During the winter, plants will be more brittle, and more likely to break. A roller chopper will put litter down in place, leaving bare areas between sagebrush plants. Chaining will drag litter, dispersing it over more area. Using a light chain (30 lb per link), it would not uproot sagebrush plants, especially if the Cats are used side-by-side forming a uniform loop with the chain. When Cats get

into a J-loop, the chain causes more disturbance and is more likely to uproot plants. The chain doesn't just drag on the surface, it turns and twists. Links can come off the ground at times. If a straight smooth chain is used, (nothing welded on), and 30 lb/link, may not even produce enough disturbance. That's why do twice over chaining. Need to have operators that you can work with. Control speed, etc.

Precipitation

Rain gauges for the area show 6-6.25 inches of precipitation since October 2003. Average annual precipitation per year for this area is about 9".

Stop 7: Old burn in pinyon-juniper

P-J and sagebrush area was a burned by a wildfire in 1996. It was drill seeded in the late fall/early winter with mostly native seeds (needle-and-thread, *Poa secunda*, *Penstemon palmeri*, globemallow, bluebunch wheatgrass, others). Cliffrose was also planted but disappeared. Cheat grass came in the next spring. 1996 was a drought, followed by a wet year in 1997.

There is an old photo plot to the North end.

There are still some live juniper trees that survived the fire. Wind driven fires are more likely to have some mid-sized or larger junipers to survive. Also dependent on whether the trees have foliage to the ground to carry the fire up into the crown. The older the tree the more likely it is to have a fire scar that shows.

The older cliffrose seems to not have the vigor to survive and re-sprout after fire. Young cliffrose appear more likely to basal sprout.

You're really sunk when you get cheat grass at this density. It really out competes everything else and starts the area into a cycle of fire. *Poa secunda* and *Poa fendleri*, and *Hilaria* might be something that could compete with cheat grass once they get established.

Recommends treating with something like Plateau in fall and springs, and then drill seeding the following fall. Include forbs and shrubs in the mix. Put cliffrose seed in one row of the seeder. Include some sagebrush, but it will occur eventually in this site without seeding. Treat with Plateau in the fall, then wait until the next fall to seed. Plateau will have some effect on native grasses. If want to seed right after, drill with a side cast. There has been a lot of work on what species are more sensitive to Plateau. Contact the manufacturer to find out.

The probability of fire has increased at this site with the invasion of cheat grass. This area will burn again.

Since this area is rocky, would recommend chaining or spike harrow to get the seed in the ground.

Cheat grass

Cheat grass needs high Nitrogen to grow well. Ed Redenty postulated that if you could reduce nitrogen in the soil, you could favor native plants over cheat grass. He dumped carbon in the soil; bacteria used and tied up the nitrogen. Natives took off. As soon as he fertilized, the cheat grass came back.

The density of cheat grass does not really matter. They still remove soil moisture before the other plants get started, even at low densities. Almost have to get complete removal of cheat grass to have success. And the seed bank for cheat grass lasts about two years.

Cheat grass can fall and winter germinate. If you treat in the fall, you won't get everything. Can and will germinate under the snow. Summer fires won't kill it. Does reduce the number of seeds if burn when seed is still on the plant, but does not get all of the seed. Fire can knock cheat grass back for seeding and give the new seed a chance to compete.

Cliffrose

Steve looked at records and is pretty sure that we have var. stansburiana here. Glandulosa is usually the more fire tolerant variety of cliffrose.

Age of the cliffrose plant and soil moisture may have an effect on cliffrose's ability to respond or survive a fire.

Rodents actively collect cliffrose seed. They can remove all cliffrose seed within a few days of ripening. Steve was involved in a study that looked at rodent effects. Rodents collect and cache cliffrose seed. Some of the cached seed germinates, but the rodents eat most of that.

Looked at smoke as a means to treat cliffrose seed, since some seeds require fire (chemicals in the smoke) to germinate. Improve germination and change the smell to reduce rodent detection. Put seed into a sack, and then hang over a fire for about 30 seconds. Studies are underway. Looks like it might work.

Cliffrose is episodic in its recruitment. Combination of tree encroachment and browse by game, makes it much more difficult to establish. Need to have a combination of events of seed crop, two good precipitation years in a row, opening of canopy, less use by game, and low density of rodents to get good establishment. Need open space where seedlings can get established and allowed to grow. Appears that roadways and tree cutting areas may provide some of this.

Seed crop is dependent on precipitation. They produce flowers on last year's spurs. To get a good seed crop, you need two years of good moisture.

Cliffrose and bitterbrush can take a lot of browsing and still produce a seed crop.

Most early studies showed that chaining of cliffrose did not work well. Breakage may or may not encourage sprouting. Probably have many factors that effect suitability of chaining: cliffrose variety, age, precipitation, etc.

Cliffrose origins are thought to have been from Mexico. The plants moved north and hybridized with bitterbrush.

Stansburiana are generally not fire tolerant, but the germplasm in this area appears to have a little influence from *P. glandulosa*, which makes it more fire resistant than the more northern species.

Steve would encourage some experimentation with fire and cliffrose. See if our plants are really sprouting from the base after fire.

Stop 8: Power line right-of-way

The area under the power line was treated at some point in the past to reduce vegetation cover under the power lines. Wanted to look at the response of especially the shrub component here. Utah Division of Wildlife Resources has proposed that we have a mosaic of treatments under the power line right-of-way to increase browse in the area.

Area has mountain sage and black sage in the understory.

It has been discovered that with fires in the vicinity of power lines, smoke in the power lines can allow the lines to arc and start a fire.

If remove the overstory, you will release the existing understory. Under the power lines would be similar to the response you could expect. You probably would not need to seed within existing shrub cover, because we have enough existing understory.

Before we got to this stop, we passed several areas along the 720 road where the sagebrush understory within the pinyon-juniper has died. This area would need to be seeded if the pinyon-juniper overstory was removed/reduced.

Fuel wood cutters (personal or commercial) could be used to remove pinyon-juniper overstory. In areas like this where tree densities are high, there may be concerns about residual fuel loading. You can put clauses in the fuel wood contract to keep the fuels down. Cutting the slash and dispersing it.

Cliffrose

Steve described the difference between bitterbrush and cliffrose. Bitterbrush has larger leaves with three lobes, a longer hairy stem on seed, and produces one seed per flower. Cliffrose usually has glands on the leaves, has smaller leaves with multiple lobes. There are multiple pistils on the flowers, and a short stem on the end of the seed. Bitterbrush is usually fire retardant.

Desert bitterbrush (*Purshia glandulosa*) is a low growing hybrid that has a mixed appearance between bitterbrush and cliffrose. It is fire resistant. Usually has 3-5 lobes on the leaves, some have glands, some do not.

Stop 9: Pinyon-juniper – Mountain shrub community on Arizona Strip

This was an Arizona Game and Fish Department cooperative project with the Arizona Strip BLM approximately 10 years ago. Unfortunately, there is not a lot of documentation on how the project was done. The objectives of the project were to break up the pinyon-juniper and encourage the cliffrose. It was a commercial fuelwood cut, that was then burned (spring burn after green-up), and hand seeded into cool ash. Unsure of the grass seed mix, but was described as a “range mix.” It was an adequate moisture year.

There is a definite cheat grass component now, which is not apparent from the surrounding woodland area. Fuelwood cutting took two years to compete. Cheat grass may have come up during that time period.

At another site, treatment was completed by chaining, then seeded with crested wheat grass. Very few cliffrose on that site. Crested wheat grass out competed the cliffrose.

Cliffrose is resprouting from the base. There is a sagebrush component still left on site. Ephedra also appears to be sprouting from the base in the treatment area. Good sign for treatment options.

Steve thinks that the natives are doing well. In the next 10 years the cheat grass should fade out. The size of the area (not too big, estimate 10 acres) should not be too threatening for cheat grass related fires.

Always treat for cheat.

Steve emphasized the need for setting up a study to burn and treat cliffrose and other shrubs in our area. Need to look at response given treatment, shrub ages, etc. Would be good to get a graduate student to look at.

Get aggressive in collecting native seed. Get grasses to a grower to produce seeds. A half-pound of seed planted out could produce 25-30 lbs of seed. Would be good to do experiments. Also let a contract for native plant seed collection. Develop the native seed industry for southern Utah, and then we'll have more options for restoration here. A key component to the restoration plans. Talk with the NRCS plant material center, private growers, etc.

Get some sites going with native mixes. Projects need to be well planned. Monitor to get data to backup the results of the project. Multiple activities, long term projects.

Look at native seeds in combinations. Change the percentages of species. Interseed with shrubs. Get a feel for how successful each mix would be. There appears to be some interactions between native species in terms of seedling establishment and survival. Steve can help with experimental design.

Day

3

Are we conducting revegetation projects or are we trying to restore ecological process and function? These are not necessarily the same thing. Depending on our purpose, the treatment and species options may be different.

Chaining

Steve led a discussion on what chaining does vs. doesn't do, and vs. other techniques. For restoration treatments you are trying to:

- A. reduce competition between plants, which includes removal of physical debris, other competing vegetation;
- B. create a seedbed (make soil more pliable, loose, reduce compaction, increase aeration; helps improve uniform and predictable results); and
- C. facilitate seeding

Removal of weed plants removes seeds from the seed bank. Fall removal makes the seed bed more friable, and facilitates uniform and predictable germination.

Burning

Advantages of burning are that you leave nutrients on site in a different form, remove debris, and can create a good mosaic. Reduces competition between plants. Is more cost effective. Mimics natural processes.

Disadvantages of burning are that control is critical. Seed bed disturbance is limited. Fire can sterilize soil or create hydrophobic conditions. Hydrophobic soils may not be a problem down here. May have hydrophobic conditions 6-8 months to 1 year later. Fire can create a seed bed and good conditions for cheat grass. Fire can eliminate some browse species. There are species that are not fire tolerant (e.g. sagebrush). Even recovery time for fire tolerant species is long. Can concentrate animals on site after treatment. Prescription, especially for pinyon-juniper woodland, can be very narrow or restrictive and can take years before you get the right conditions to burn. Fires do not diminish cheat grass. Need to look at fire effects on individual species.

Typically not good idea to plant in ash right after a fire. Ash may blow off site before seeds germinate. Area may have hydrophobic conditions. Seeding right after a fire (especially wildfire) may cause germination in mid-summer and increase seedling mortality.

Mechanical Practices

Chaining. The goal is to reduce competition, but don't need to remove all plants. Can reduce cover, leave patches, leave only larger trees, only smaller trees, etc. When dealing with tree communities you have to deal with large equipment. Have to deal with aesthetics of removal, public may not accept visual impact of chaining. Changes in cheat grass or sagebrush density are

not as big a visual effect as the removal of trees, especially the first and second years after treatment.

Techniques of mechanical treatment include: hand cutting, chaining or cabling, roller chopper, shredder, mower, bullhog.

Disadvantages of mechanical treatments. To reduce costs of treatments, you want to find ways to do as much of the treatment needs (reduce competition, prepare seed bed, and seed) at the same time. Roller chopper reduces competition, somewhat prepares the seed bed, and usually has a seeder mounted on top. Only a small amount of seed actually gets into the depressions created by the roller chopper. Most is just pressed into the soil. Won't work well for large seeded species. Cost is high (\$200-300/acre). Similar to the roller chopper, the aerator is less expensive (\$100/acre), but only works in the sagebrush. Will not deal with trees. Chaining would uproot larger trees. If you only chain one way, trees will not be completely pulled out, but only pulled over. Brittle trees can break off. Smaller trees (8-10 ft tall) will be bent over, but generally not pulled out. These can recover and survive.

Many of the mechanical treatments have similar problems with damage to archeological sites. Chaining and disking would have similar damage to sites. Most mechanical treatments need to avoid archeological sites. Additional study is needed for scattered archeological materials (lithic scatter, etc.).

Chaining in sagebrush in one direction would have very little sagebrush plants pulled out. If you conduct the treatments in cold temperatures, these plants are crushed and it limits soil disturbance. If conducted in warmer temperatures, plants will bend more.

The amount of debris and disturbance created by chaining is dependent on the speed of the Cat and how much the Cats travel together. Cats should be close together and side by side to lessen pulling shrubs out by the roots and increasing soil erosion.

With Bullhog treatments, if you get 1-2" of juniper litter on the ground, that will effect seed germination. Seed needs to be in the mineral soil. Mulch will help protect soil moisture, but needs to get to a depth less than 1". Some treatments burn mulch to reduce it.

When chaining treatments first started, they did not see enough uniform and adequate seedbed preparation. They ended up welding individual links with railroad rail to increase soil disturbance and removal of small trees. The railroad rail through a link (18") created more disturbance and created grooves. The paddle attachment on either side of the link made less disturbance, and more tillage. Chains are usually approximately 300 feet long, and most of the soil disturbance is along the sides, not the bottom of the loop. Debris accumulates at the loop, and the chain has to leave the ground in order to get over the debris. Steve says that it is an "old wives tale" that chaining creates open ground and erosion. When they did a double pass of an Ely chain, only 30-40% of the cover was removed (Lee Hughes, in Nevada). A 30-60 lb chain will only remove about 50% of the sagebrush. There was concern for tree root depressions, but they generally filled in quickly. Debris piles were homes for rabbits, which had a major effect on seedling establishment.

If treating an area with inadequate understory, you have to seed and you need an adequate seedbed. PUME, PUTR, ORHY, STIPA must be seeded into the soil, 1/2" – 1" deep. It will not be successful without getting the seed into the ground. Poa, crested wheat, sagebrush can be surface planted. Shallow litter is good, but can be planted with less seedbed preparation.

Crested wheat grass is so widely used because it is successful over a wide range of areas with little seed preparation, it has early germination, and is also inexpensive.

Indian rice grass has a hard seed coat and dormant embryo. It also has ecotypes, so need to find right seed source. It is programmed to germinate during unusual moisture. Needs to be seeded deep in the soil so it doesn't germinate until there is good moisture and it can survive. Needs to be planted 1-3" deep. It has erratic germination, not uniform. May take 1-3 years to germinate. Dormant seed comes from more drought tolerant plants. But when it does come, it is very hardy. May take 3 years to really get a good establishment.

Western wheat grass evolved seed that doesn't all germinate at the same time. Thin seed. Needs to be planted at least 1/2". It is a slow developing seedling. Once established, it is very hardy. Have to plant enough of it.

Poa fenderlia and *P. secunda*, will work well with light tillage or aerial seeding.

Bitterbrush, cliffrose, and ephedra all have large seeds. Rodents can collect 89% of seed within a couple days of ripening. Will eat and cache. Rodents also eat seedlings. Seed must get in the ground. Seed dribbler on a Cat drops seed on the Cat track and punches the seed into the ground. Works well.

Most native forbs are variable. Composites generally plant pretty freely. They don't have to be deep planted. Globe mallow have seed dormancy. Can be slow to germinate. Native plants don't germinate uniformly and may take a few years to germinate and get established.

Cliffrose is very slow to regenerate. It is important to keep residual plants to produce seeds when the right conditions do occur.

Seeding in ash after fire does not work. Usually wrong time (mid-summer), they germinate with the summer rains and then dies. Ash blows away and does not cover the seed very well.

You want to seed late enough in the fall that the seed doesn't germinate too early (e.g. November or December).

Native vs. non-native seed mixes

Grasses are the main issue. Forbs and shrub exotics are just not adapted to this area. Small burnet and alfalfa will not spread and you'll be lucky to keep it. Alfalfa might last 30 years. Small burnet might last 15 years. Alfalfa does not diminish the establishment of native species. They could be planted for forage or an attractant for animals to an area. They might be acceptable transition plants. Pure stands of alfalfa could increase nitrogen in the soil and increase cheat grass, but in a mix it would probably be fine.

Crested wheat, intermediate wheat grass, orchard grass, and smooth brome could be used in pinyon-juniper sites. Crested wheat grass may last for 20-40 years in a sagebrush type. In the pinyon-juniper sites (12-14" precipitation), crested wheat grass will last forever. Crested wheat grass has a competitive effect on native forbs and shrubs. It is not compatible. If you use crested wheat grass in areas with 12" or more annual precipitation, you will not be able to restore the forb and shrub component. Even in small amounts in a seed mix. However in areas with less than 12" annual precipitation, crested wheat grass will have problems during drought years. However, during good precipitation years, it will still limit the ability of the native plants to get established. Crested will fade in 20-40 years, but it will reduce recruitment of natives in the mean time, slowing the recover of the native plant community. If we want restoration of native system, we can't put crested wheatgrass in the seed mix. If the choice is cheat grass or crested wheat grass, you may have to use crested wheat grass until a larger native seed source is developed, then deal with removing the crested wheat grass later.

Intermediate wheat grass and smooth brome in areas with 12" annual precipitation or more is a much more scary story. They displace shrubs. The Kanab Field Office site had a lot of this. Will be interesting to monitor that site. Intermediate wheatgrass there appears to be spreading and might out compete sagebrush, cliffrose, and bitterbrush. In lower precipitation zones they will not persist, if they would ever germinate. They also have several varieties. Southern strains are more drought and heat resistant. But they are a good forage plant for game.

There is no reason that we couldn't get native seed in amounts we need in 3-5 year if we actively pursue it. Need to encourage seed collectors in this area. Advertise each year for native local seed to develop the market. May need to look at a Plan Amendment to assist in encouraging seed collection. Utah Division of Wildlife Resources (Tyler) has difficulty getting permits, and there are limits to machinery, etc.

Russian wild rye is drought resistant, but needs calcareous (calcium based) soils to persist. It is best adapted to sites that also support greasewood and shad scale. In a mix with native seed, it was pretty competitive in areas where it was adapted. It would do all right if seeded in a mix with natives. If natives were not already in the area and not seeded, they would probably not come in. Russian wild rye would probably persist longer than crested wheat grass.

You could plant crested wheat grass in a native mix if plant at 24" wide or more to reduce the competition with the natives. Should have limited inhibition of native species, but still use crested wheat in the mix. Would be good to monitor to make sure this works.

Priorities for Treatment

Steve Monsen doesn't think that sagebrush areas are quite in as much peril as we thought last year at this time. Would be more important to treat areas in the pinyon-juniper woodland where the sagebrush has died out. In his mind, this would be higher priority than the sagebrush areas. Need to get shrubs and other understory components back into those pinyon-juniper areas. Would need to remove/reduce tree canopy and seed. Need to pay attention what species of sagebrush to seed in those areas: black sagebrush or Wyoming sagebrush.

Another high priority area for management for Steve was to develop a program of pinyon-juniper treatment in areas where the understory is still intact. These areas would not need a lot of seeding. This is probably large areas. Look in the lower elevation sites where pinyon-juniper has encroached and in higher elevation sites where pinyon-juniper has become too dense for the understory shrubs to compete well.

Need to treat large enough areas to deal with mule deer use. First couple of treatments may need to be large numbers of acres, but not necessarily large stands. Could do several smaller stands in an area. Mimic natural patters. Need to monitor ungulate grazing after treatment. Deer numbers may be an issue as well. If we see that deer use is too high for the area, Adam Bronson (UDWR) can look at reducing deer numbers. We would need to be very localized with the deer hunts. Adam said that now is the perfect time to start these treatments because drought has already knocked deer numbers down with poor fawn recruitment. We will need to manage grazing to facilitate recovery of shrubs. Operators need to be told that it might be a long time until they can graze treated areas.

Cheat grass infested areas are of concern. It would be good to at least plot out areas that are already infested in cheat grass, or have high potential for cheat grass infestation. Areas of cheat grass infestation should be treated independently and aggressively. Need to look at grazing plan, treatment options, potential for wildfire, etc. Rank areas by priority when evaluating the areas with other resources in mind (e.g. fire, wildlife, expansion probability, road network, etc.). Cheat grass areas need to be treated aggressively after wildfire. Would be good to have seen ready to go when a fire happens. With the restoration plans the Monument has in the future, we may be able to change priorities for seeding when a wildfire happens and redirect already purchased seed to priority areas.

Tebithyron (SPIKE)

Works well if you get the right precipitation. Treatment can be used to release existing understory by removing overstory. Can treat individual plants. Kills trees, and other plants. Grasses are weakened, but not killed. Need to have an existing understory to work. Fall application works best. It's cheaper than mowing.

Monitoring

Monitoring is key to learning and figuring out the system. Steve Monsen is willing to help out with study design, and making appropriate contacts.

Steve Monsen suggested that he could help organize an additional field trip to look at existing treatments and research applicable to the restoration we have been talking about.

APPENDIX A

Dr. Stephen B. Monsen Biography

Stephen B. Monsen is a retired Botanist/ Ecologist from the USDA, Forest Service, Rocky Mountain Station, Shrub Sciences Project, Provo, Utah. Steve was born and educated in central Utah. His parents and grandparents were live-stock operators and Steve spent most of his summers herding sheep on the Wasatch Mountains.

He attended Snow Junior College in Ephraim, Utah and received his BS from Brigham Young University in Agronomy and Animal Science. He remained at BYU working toward a Masters Degree in Botany and Range Science. For his master study, he spent two years in Jackson, WY investigating the impacts of elk grazing on portions of the Gros Ventre drainage.

Upon completion of school in 1960, he was hired by the Utah Fish and Game Department to participate in a study dealing with the restoration of big game winter ranges. Studies were located at the historic Great Basin Research Station, Ephraim. This is the oldest watershed and range station in the West. At this location, Steve became acquainted and was tutored by A. Perry Plummer, one of the early scientists associated with range and habitat improvement. Scientists at the GBRS center were involved with the first efforts to restore native shrubs including big sagebrush and rubber rabbitbrush. Although these species were recognized as important browse plants, seeding sagebrush on deteriorated rangelands was not popular with many land managers. The project was involved with studies to restore woody and herbaceous plant communities. Seed cleaning and planting equipment were developed to harvest, process, and plant a number of new species.

In 1968, Steve was transferred to Boise, ID to work as a Forest Service Scientist at the Forest Sciences Laboratory. At this location, Steve was assigned to develop restoration practices to stabilize logging roads and logging disturbances that had caused considerable damage to the Salmon River drainages. He was assigned to develop plant materials, planting techniques, and erosion control measures to stabilize steep and harsh disturbances.

Two years after arriving in Boise, Steve was reassigned to the Utah Big Game Project that had been relocated to Provo, UT. Steve was assigned the added responsibility to investigate and develop plants and restoration measures to restore game and range-lands in Idaho. He ultimately developed a long-term cooperative project with Idaho BLM to investigate the restoration of cheat grass infested range-lands. This project ultimately grew to aid the Bureau and Forest Service in establishment of the Great Basin Initiative and the Native Plant Programs.

In 1998 and 2000 he was able to establish an extensive project with BLM to initiate the development of a native forb program for the Great Basin. The project includes selection and identification of site adapted ecotypes for the semi arid shrub lands, and the involvement of commercial growers to produce material to restore big sagebrush sites currently occupied by annual weeds.

Steve was invited by the New South Wales Government, Australia to evaluate their range programs and furnish recommendations to redirect their research efforts. His suggestions lead to increased cooperation with scientists from both countries, and the establishment of a native plant

restoration program within this state. Steve has been responsible for the release of numerous native plants for range, watershed, and wildlife restoration. He has authored many articles and books, and has sponsored and directed various workshops and symposiums throughout the West.

He is particularly interested in conditions on the Colorado Plateau, and the similarities of problems that exist in the tree and shrub lands within the Great Basin. He is committed to the improvement of range and wild lands that have been seriously altered and currently fail to sustain the multitude of resources they are capable of.

APPENDIX B.

List of Invited Participants

<i>Who</i>	<i>Organization</i>
Barber, Harry	GSENM
Beck, Holly	GSENM
Beckstrand, Randy	Kanab Field Office, BLM
Birmingham, Steve	UT Dept of Agriculture
Boyd, Hilary	AZ Strip BLM
Briggs, Paul	Cedar City, BLM
Bronson, Adam	Utah Division of Wildlife Resources
Brown, Norris	Grazing Permittee
Brown, Worth	Grazing Permittee
Chapman, Paul	GSENM
Chaudhary, Bala	NAU graduate student
Church, Lisa	Kanab Field Office, BLM
Decker, Cheryl	Zion NP
Despain, Del	Univ of Arizona/AZ Strip
Dunham, Edgar	Grazing Permittee
Eaton, Marietta	GSENM
Fertig, Laura	GSENM
Franklin, Scot	Arizona Strip BLM
Gisler, Jan	Private, Friends of GSENM
Glover, Clint	Lowlanders Group
Goheen, Andy	Arizona Strip BLM
Goheen, Sue	GSENM
Goldring, Kenneth	Grazing Permittee
Habbeshaw, Mark	Kane County
Hatch, Julian	Greater Boulder Group
Herder, Mike	Arizona Strip, BLM
Houston, Micky	Lowlanders Group
Houston, Robert	Lowlanders Group
Howard, Tim	North Kaibab Ranger District
Hughes, Lee	Arizona Strip, BLM
Hunsaker, Dave	GSENM
Johnson, Calvin	Grazing Permittee
Johnson, Que	Grazing Permittee
Kolle, Liz	GSENM
Louie, Denise	Zion NP
Malm, Margaret	Zion NP Volunteer
Marlin, Yvonne	Zion NP
Martinez, A.J.	Utah State Office, BLM
McKee, Norman	GSENM MAC
Messerly, Doug	Utah Division of Wildlife Resources
Messmer, Terry	Utah State University
Oyler, Ricky	GSENM
Palmer, Brett	GSENM
Payne, Val	UT Dept Natural Resources
Pope, Dennis	GSENM
Redman, Andrea	NAU graduate student
Roundy, Alvin Brett	Grazing Permittee

Roundy, Brett	Grazing Permittee
Sandberg, Bob	Arizona Strip, BLM
Siders, Melissa	GSENM
Small, Mike	Arizona Strip, BLM
Smith, Don	North Kaibab Ranger District
Smith, Luke	Utah Division of Wildlife Resources, Price
Stewart, Sean	GSENM
Sutcliffe, Kent	USDA, NRCS
Thomas, Kyra	North Kaibab Ranger District
Thompson, Tyler	Utah Division of Wildlife Resources
Torgerson, Ron	Utah School Trust Lands
Warner, Barb	Private, Education
Wolf, Dave	GSENM
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All GSENM Employees	

APPENDIX C
Sagebrush and Pinyon-Juniper Ecology and Restoration Workshop Agenda

A Workshop Lead by Steve Monsen
Sponsored by the Grand Staircase – Escalante National Monument

Location: Monument Headquarters, 190 East Center Street, Kanab, UT
Dates: Tuesday May 11 thru Thursday May 12, 2004
Times: 8:00 am to ~ 5:30 pm May 11 and 12.
8:00 am to noon May 13.

Note: Agenda may be changed if we run over allotted time during discussions sessions in the field.

DAY 1 – Sagebrush Die-off and Failed Seedings
Tuesday, May 11, 2004

8:00 – 8:45 am

Meet in the Dance Hall Rock Conference Room, south wing
(Visitors should obtain guest pass from front desk)

- Attendees sign in.
- Welcome and introductions, distribute agenda, maps, etc.
- Workshop goals
- Review agenda – any additions or changes?
- Review maps for field trip
- Split up into carpool groups

9:00 am

Field trip convoy leaves headquarters
(~9:00 – 9:40 am = Travel time)

~9:40 – 10:40 am

First site: Five-mile Mountain seeding and sagebrush die-off

Discussion topics:

- Drought, fire, and sagebrush community health.
- Recommended livestock grazing strategies.
- Recommended sagebrush restoration methods.

(~10:40 – 11:00am = Travel time)

~11:00 am – 12:00 pm

Second site: 'Failed' seedings in the Telegraph Flat Pasture.

- Note the condition of the sagebrush communities and old seedings in this area as you drive. Look for invasive species and note the amount of bare soil.

Discussion topics:

- Drought, seeding health, and livestock grazing.
- Recommended restoration methods.
- Native vs. non-native seed mixes.
- Seed application methods and timing of application.
- Soil erosion and impacts to soil ecology related to seedings and restoration activities.

12:00 – 1:00 pm

Lunch? (Might want to pick a site with some trees?)

(~1:00 – 1:40pm = Travel time)

~1:40 – 2:40 pm

Third site: 'Failed' seedings and old burn in Seaman Wash.

- Continue to pay attention to condition of sagebrush and seedings and look for invasive species as you drive.

Discussion topics:

- Drought, seeding health, and livestock grazing.
- Recommended restoration methods.
- Native vs. non-native seed mixes.
- Seed application methods and timing of application.
- Soil erosion and impacts to soil ecology related to seedings and restoration activities.

(~2:40 – 3:40pm = Travel time)

~3:40 - 4:40 pm

- Fourth site: Kanab Field Office site near Mt Caramel Junction – Barracks Point and Twin Hollow Chaining (mid to 1960s to late 1970s). Lisa church will provide background information on this 900 acre reseeding. This site gets 'good' moisture and was not significantly impacted by the drought. It is typically winter grazed and provides critical winter range for mule deer.

Discussion topics:

- Why is this site relatively successful when others are negatively affected by drought conditions?
- Treatment options, seed mixes, etc.

~5:40 pm

Workshop concludes for the day.

**DAY 2 – Buckskin Mountain: Pinyon – Juniper Encroachment, Mountain shrub Enhancement, Sagebrush Die-off
Wednesday, May 12, 2004**

8:00 – 8:30 am

Meet in the Dancehall Rock Conference Room, South Wing
(Visitors obtain pass from front office)

- Introduce any new attendees.
- Discuss agenda and planned site visits.
- Discuss any changes to agenda.
- Review maps.
- Split into carpool groups

8:45 am

Convoy departs headquarters for the Buckskin Mountain area, east of Kanab.

(~ 8:45 – 9:15 = Travel time)

~9:15 – 10:00 am

First site: Old pushes (PJ treatments in sagebrush) on the Buckskin.

- Note the condition of sagebrush communities in this area as well as old 'pushes' in the sagebrush. Look for the old PJ skeletons to indicate the pushes. Also note cheat grass if any.

Discussion topics:

- PJ encroachment (when is it encroachment?).
- Appropriate treatment options.
- Issues with treatment (species mixes, invasive species, soil erosion, etc.)

(~10:30 – 10:40 = Travel time)

~10:40 – 11:20 am

Second site: Sagebrush die-off

Discussion topics:

- Drought, fire, and grazing impacts to sagebrush communities.
- Recommended restoration activities.
- Seed mixes and application methods.

(~ 11:20 – 12:10pm = Travel time)

~12:10 – 1:30 pm

Third site and Lunch: Old burn in PJ

- Note the condition of the PJ and the shrub component as we travel.
- Note changes in plant communities related to elevation.
- Look for decadent cliffrose.

Discussion topics:

- Fire as a tool in PJ: When is it appropriate? What are the risks?
- Predicting plant community outcome if fire is used.
- Cheat grass invasion.

(~ 1:30 – 2:00 pm = Travel time)

~2:00 – 2:45 pm

Fourth site: Power line right-of-way.

- Continue southeast along the 720, turn south on the 735.
- Continue past the intersection of the 717, until we hit the power line right-of-way.
- Note the general condition of the PJ and shrub component and look for cheat grass invasion and decadent cliffrose.
- Note changes in plant community related to elevation and aspect.

Discussion topics:

- Response of shrubs to cutting treatment.
- Treatment options in mountain shrub/cliffrose communities to improve 'health' of cliffrose and ultimately provide better ungulate food.

(~ 2:45 – 3:45 pm = Travel time)

~3:45 - 4:45 pm

Fifth site: PJ-Mtn shrub community treated to improve shrub component (burned and coppiced) on the Arizona Strip. This site was burned approximately 8-10 years ago. It is a woodcutting area that had a prescribed burn done on it to control slash. Ample spring moisture has contributed to a wealth of cheat grass!

Discussion topics:

- Andy Goheen will discuss site history, treatment, goals, and outcome.
- Fire as a management tool to increase sprouting in cliffrose community.
- What are the risks associated with using fire?
- How would the treatment result differ without the use of fire?

~ 4:45 pm

Workshop concludes for the day

DAY 3 – Closeout session
Thursday May 14, 2004

8:00 am – 12:00 noon

Meet in the Dance Hall Rock Conference Room, South Wing
(Visitors obtain guest pass from front office)

- Review field trips and synthesize important take away messages.
- Take questions and comments from the group.
- Monsen may want to include additional relevant topics not covered in field here.
- Provide attendee list to group.

APPENDIX D.

Requested Agenda Items for Monsen's Sagebrush and PJ Ecology and Restoration Workshop

- 1)** Fire as a management tool in Pinyon-Juniper stands.
What are the risks?
What are the extenuating or existing conditions that might yield undesirable results from burning in PJ?
What about using fire in areas where there is PJ die-off or mortality?
What are the issues associated with undesirable species invading burned PJ stands?
When is it appropriate to use prescribed burning in PJ stands?
- 2)** Appropriate restoration activities in sagebrush communities and old seedings with respect to soil ecology and soil erosion (including issues associated with soil crusts).
Which methods are applicable?
Which methods are less invasive/intrusive/destructive to physical and biological soil components?
What level of soil degradation or erosion is acceptable and/or reversible?
Inoculation treatments for biological soil crusts?
- 3)** Same question (as #2) for treatments in PJ/Mountain shrub communities.
- 4)** PJ encroachment and invasion.
Where is PJ encroaching versus where is PJ expected on the landscape?
Any well defined/known limiting factors or indicators to indicate where PJ is expected? Not expected?
How do we figure out where sagebrush, juniper, and pinyon-juniper should be vs where they are now?
- 5)** Cliffrose shrub communities and treatments to improve conditions and health of these communities.
How do we increase and favor regeneration?
What types/forms/hybrids of cliffrose (*Purshia mexicana*) do we have?
Do we have any desert cliffrose (hybrid of *P. tridentate* and *P. mexicana*)?
How should treatments differ for different hybrids?
What treatments are appropriate? (fire effects, coping effects, etc)
- 6)** Old pushes ... what do we do with them now. Let them grow back in, keep them in grass/sagebrush, what? (refers to areas where 'invading' PJ was bladed or 'pushed' over to remove it).
- 7)** Seed mix in sagebrush, and pinyon-juniper. Is it worth putting cliffrose seed in the mix? What sagebrush seed? Local source vs. not so local source?